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INVESTMENT MODELS ON CENTRALIZED AND DECENTRALIZED CRYPTOCURRENCY MARKETS

Purpose. Significant capital inflows in the cryptocurrency market and record-breaking prices on cryptocurrency assets have led to the creation of alternative investment options on cryptocurrency markets, including a new field of decentralized investing, known as decentralized finance, operating on smart contracts. The objective of this study is to review investment options in the industry sector available to investors on cryptocurrency markets and decentralized protocols.

Methodology. The model of decentralized cryptocurrency exchanges was used in the article. It is based on providing liquidity into the liquidity pool.

Findings. The results of this study demonstrate that new industrial cryptocurrency investors have a wide range of investment options that can outperform strategies like passive holding of cryptocurrency or investing in the stock. Given the liquidity mining model attracts early investors, they need to look at assets such as governance tokens of different platforms. The Sharpe ratio of COMP and UNI tokens is higher than S&P500. In addition, these tokens are mined via a liquidity mining model.

Originality. The crypto market has been growing rapidly since the beginning of the pandemic. The calculations for crypto assets might be influenced by the "bull run" on the crypto market because the last time such high Sharpe ratio for BTC and ETH was observed during the 2017−2018 cryptocurrency bubble. Investing in the crypto market is riskier than investing in the stock market due to high operational risks. Crypto market investors might prefer to mine or buy UNI or COMP tokens to diversify their portfolios.

Practical value. According to the analysis results of the received information, a Sharpe ratio of investments in protocols for loanable funds is lower compared to investment options on the stock market or CeFi lending. It is also potentially riskier due to volatile interest rates and high operational risks.

Keywords: *investment models, cryptocurrency, AMM, PFL, DEX, LP, interest rate, risk*

Introduction. In February 2021, the price of Bitcoin cryptocurrency crossed a new record of $58,000, and the total capitalization of the cryptocurrency market increased to almost $1.5 trillion. This increase in prices on partially regulated assets has been the subject of discussion for investors since the emergence of cryptocurrencies. The economic response to the COVID-19 pandemic involving "helicopter money" and public fears of inflation, a reduction in the real sector of the economy, increased operating pressure on businesses, and new business requirements prompt economic agents to seek new investment opportunities.

Cryptocurrencies are recognized as an alternative type of investment worldwide [1], as ownership of records in a distributed database does not belong to any of the usual categories of equity/income/money. Cryptocurrencies, smart contracts, and related technologies are extremely relevant issues in cross-domain research, covering economics, programming, information security, cryptography, et.

In 2017−2018, a new form of financial interaction appeared in the concept of the cryptocurrency market − decentralized finance (DeFi). DeFi is an experimental form of financing that does not depend on centralized financial intermediaries that offer traditional financial instruments, but in contrast, allows investors to create financial instruments based on smart contracts. The DeFi concept enables market participants to borrow and trade cryptocurrencies, hedge risks, and use derivatives without a centralized intermediary. Some DeFi protocols for loan funds offer up to 20 % interest rate returns each year. DeFi began to attract the attention of existing and new investors in cryptocurrency due to its high return on investment. This is eloquently evidenced by the fact that only from March 2020 to February 2021, the total value locked in the DeFi ecosystem increase from 1 to 45 billion US dollars.

Literature review. Cryptocurrency is a digital asset that performs one of the classic functions of money − a medium of exchange, when individual records of ownership of coins are stored in a distributed cryptographically protected database [1]. Cryptocurrencies algorithmically control the minting of new coins and check the transfer of ownership of them. The first and most famous cryptocurrency is bitcoin, which was launched in 2009 [2].

An important part of most cryptocurrencies is their decentralized nature, which is ensured by storing information about transactions in a decentralized blockchain repository, as well as decentralized characteristics of transaction processing in the network. The Blockchain system (distributed database) is stored on "nodes" − computers on which cryptocurrency software is installed. Blockchain security is based on the use of a mechanism to verify the legitimacy of a transaction by miners using a certain consensus algorithm.

Cryptocurrencies have been studied as a potential medium of exchange [3], a store of value [4], and alternative investment [5]. In securities trading, the price of bitcoin directly depends on its volatility (increasing volatility automatically causes an increase in price). Thus, the value of virtual currency directly depends on the value of trade [3]. Projected inflation, public blockchain, and a fixed supply of cryptocurrency may interest investors seeking alternative ways to reduce inflation's impact on their savings [6, 7].

The co-founder of cryptocurrency Ethereum V. Buterin emphasizes that "the decentralization of cryptocurrency affects security, which in turn affects the scalability of cryptocurrency, which affects decentralization" [8]. This concept is

true for cryptocurrency as an inclusive, decentralized, large-scale and secure means of payment.

Cryptocurrencies are already widely used in electronic payment systems (for example, stocks from Burger King and Coca Cola with unique gifts for those who used cryptocurrency for payments). The world's largest companies that use cryptocurrency payments in e-commerce rely on market leaders of cryptocurrency payment providers such as BitPay, Coinbase, Flexa, or create their own integrations with cryptocurrency networks [9, 10].

The cryptocurrency market is less stable and more volatile compared to traditional markets. For example, according to [11] a single tweet by E. Musk raised the Bitcoin's price from 33,000 to $37,000. At the end of 2021, the capitalization of only two cryptocurrencies Bitcoin and Ethereum is the largest in the cryptocurrency market.

The use of cryptocurrencies in Ukrainian online stores can potentially solve the problem of high commissions, or partially eliminate it for certain types of transactions. Since 2017, the commission of the Bitcoin network has been stable, but in early 2018 and 2021 there are significant increases in the commission (Fig. 1).

More than 25 % of Bitcoin transactions (Fig. 2) account for up to $25. That is, in 25 % of cases, the use of Bitcoin leads to a similar fee for transactions that exceed $25 when using LiqPay. For transactions with a total value of more than $25, it is more profitable to use Bitcoin than LiqPay. In the other 25 % of cases, using the Bitcoin network is more profitable than LiqPay at a transaction cost of up to $50.

Ethereum is a cryptocurrency created for programming smart contracts in a decentralized environment. A smart contract is a computer program or transaction protocol designed to automatically execute, monitor, or document legally important events and actions in accordance with the terms of a contract or agreement [12]. The objectives of smart contracts are to reduce the need for intermediaries, losses from fraud, malicious and accidental actions. The concept of smart contracts became popular after the release of the cryptocurrency Ethereum.

The high level of abstractions implementation on the Ethereum platform allowed its developers to create complex financial instruments, such as credit and investment funds, cryptocurrency based on Ethereum blockchain, and interaction conditions that emulate decentralized autonomous organizations using blockchain currency or cryptocurrency [13]. This experimental form of financial interactions is called decentralized finance.

As was mentioned before, decentralized finance (DeFi) is an experimental form of financing that is independent of central financial intermediaries (such as brokerage firms, exchanges, or banks), allowing the creation of financial instruments based on smart contracts. DeFi protocols allow economic agents to borrow and exchange assets, speculate on price changes using synthetic derivatives, insure against risks, and so on.

Given the current implementation of DeFi concept is based on Ethereum, the record-breaking prices of transactions on Ethereum network demonstrate the increasing interest in DeFi (Fig. 3).

The cryptocurrency field features special kinds of risks that are not applicable or very unlikely to happen in the field of traditional finance. Software vulnerabilities, pseudo-anonymous transactions, human and technical errors, fraud activity — all these factors are raising the bar of cryptocurrencies' risk. Moreover, the DeFi concept introduces new risks associated with operational security because the development team can manipulate smart contract's parameters. Also, it is not possible to update the smart contract code to patch a vulnerability in it after the initial deployment.

Automated Market Makers (AMM) is a part of decentralized exchanges. Varying network transaction fees and time-consuming confirmations of transactions do not make the adoption of order book models financially wise for the concept of decentralized exchanges (DEXs). AMM are algorithmic agents or smart contracts that automatically provide liquidity in electronic markets [15]. AMM combines liquidity and sets prices using a deterministic pricing formula instead of setting supply and demand prices (for example, Bancor [16], Uniswap, Kyber Network [17], etc.). Therefore, it eliminates the need for counterparties on DEX.

The term "Protocol for loanable funds" (PFL) was coined in the research [6]. PFL is a model of the loan market in which lenders receive interest on such lending. Given that cryptocurrencies do not require permits and trust, their protocols should protect borrowers from defaulting by requiring them to over-secure loans, allowing the lender to redeem collateral if the borrower fails to meet its obligations.
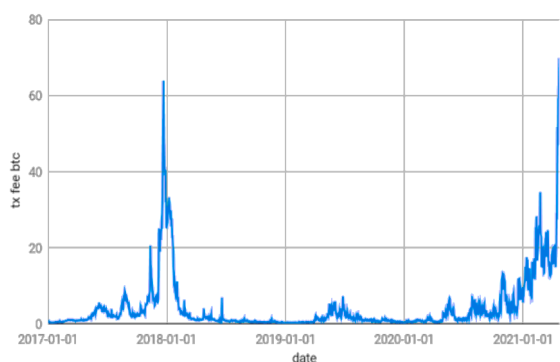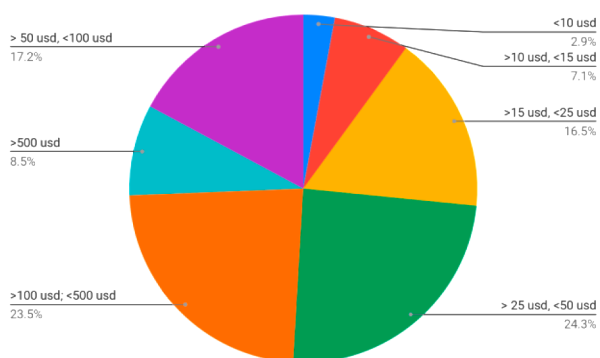

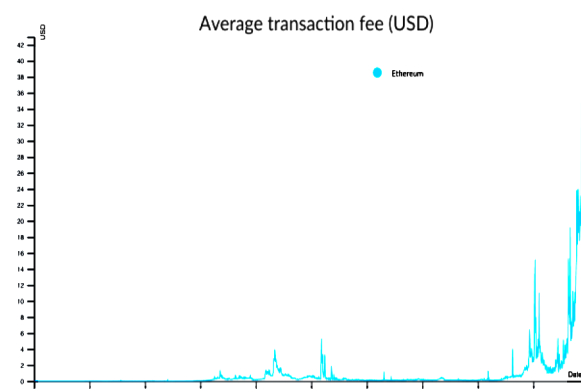Fig. 1. The cost of a transaction on the Bitcoin network in US dollars [8]

Fig. 2. Allocation of transaction costs when the use of LiqPay & Bitcoin leads to the same commission, 2017–2021

Fig. 3. Historical data for average transaction fee on Ethereum network [14, 15]

The peculiarity is that the borrower stops paying the loan when the value of the blocked collateral falls below a certain fixed level. Liquidation thresholds differ in different asset markets and different protocols. In the default conditions, the credit protocol seizes and liquidates the blocked collateral at a discount to cover the principal amount of the debt. In addition, the penalty is accrued on the amount of the debt before the payment to the borrower of the balance.

For the future integration of cryptocurrencies as the main means of payment, as well as part of electronic payment systems, it is necessary to understand the features of cryptocurrencies that make them available for use in electronic payment systems. Among the trends in the development of electronic payment systems are:

1) the inclusiveness of the payment system;

2) the security of the payment system;

3) the digitalization of the payment system.

Purpose. The purpose of the research is to review investment options available to investors on cryptocurrency markets and decentralized protocols, their advantages and disadvantages, leading market players operating in this field, expected investing efficiency, risks to investors.

Methods. The model of lending is traditional for the economic system. The cryptocurrency market attracts investors accustomed to using conventional financial instruments, such as short positions and margin trading. However, specific financial instruments require an option to get a loan on a cryptocurrency exchange. Therefore, the savings account model began to appear on centralized exchanges (for example, Binance, Bitfinex).

Binance, the largest crypto exchange by daily trading volume ($30B), allows users to put their cryptocurrency assets on a savings account. Annual Percentage Yield depends on the type of investment. For example, in February 2021, the average APY for Bitcoin is 1.2 %; for less popular cryptocurrencies, this rate can reach 0.2−0.3 %. For stablecoins, crypto tokens are bound to the US dollar. For example, DAI, USDC, and USDT, the interest rate equals 6 %. It is also important that the offered interest rate may vary. For instance, Binance exchange calculates this rate based on stats from the last seven days.

The lending concept is not new for centralized cryptocurrency platforms. Good example of cryptocurrency lending in CeFi is "Block.Fi" platform − the first platforms for loans developed in 2017. As of February 2021, many other popular exchanges such as Bitfinex (4th in the world by daily trading volume [18, 19]) and Crypto.com (22nd in the world by daily trading volume [20]) have implemented a model of savings accounts for their users [21].

The spread of the interest rate across different platforms is noticeable. The interest rate on BTC varies greatly between platforms for loans and exchanges − 1.2 vs. 3.2 % (Table 1). This significant variance may be explained by the fact that crypto exchanges first of all hunt for fiat money, tokens, et. Crypto/fiat markets generate the bigger part of daily trading volume on exchanges such as Binance and Bitfinex, so it is likely that investors are interested in financial instruments tied to fiat currencies.

Also, the interest rate on CeFi platforms is unstable. For example, BlockFi mentions that the interest rate might vary over time. CeFi platforms do not provide historic data for lending rates, but it is possible to confirm the interest rates were lower before BTC price started increasing in 2020. The interest rate on Binance for USDT stablecoin on 21 July 2020 was only 0.87 % [22].

Another problem is that the savings rate on CeFi platforms is closed source and unpredictable. Investors can only see APY available to date.

Thus, the model of CeFi lending represents a traditional savings model with daily interest compounding

$$P' = P\left(1 + \frac{r}{n}\right)^{nt}.$$

Table 1

Average APY % during February 2021 for investments in USD and BTC on CeFi platforms [14, 19−22]

CeFi platform	APY% USD coins	APY% BTC
Binance Earn (flexible)	6.0	1.2
Block.Fi	4.5	3.2
Crypto.com	6.0	–
Bitfinex Pro Lending	6.51	1.82
CoinList	2.92	2.92

Due to PFL requirements and the liquidity pool model, the DeFi ecosystem is based on total value locked, which is the value of all tokens blocked in various DeFi protocols (e. g., loan protocols, derivatives protocols) [21, 22]. This indicator increased from less than $1 billion in March 2020 to $45 billion in February 2021.

Compound [8, 11] became the first protocol for loan funds in DeFi. In PFLs, entities can borrow from the general pool by providing collateral in excess of the loan amount. The borrower is obliged to repay the borrowed funds with interest (Fig. 4). Other popular PFLs are dYdX, AAVE, InstaDApp. As of February 22, 2021, the total TVL in the PFLs protocol is $ 19.27 billion [22, 23].

PFLs accrual interest per blockchain block. The amount of interest that must be paid by the agent who borrows funds depends on the protocol spec, pool size, current market liquidity, characteristics of borrowed assets, and other factors. Also, in different protocols, interest rates can be calculated differently: linearly, non-linearly, and others. Given that the operations are performed on a public blockchain, the PFL model can be considered transparent compared with the closed CeFi lending model.

In general, the model can be represented as

$$P_{k+1} = P_k(1 + r_k),$$

where k represents the number of the block and r is the interest rate for block k.

For example, for Compound protocol, per-block accrual can be represented as

$$P_{k+1} = P_k + (P_k(i_{k,b}(1 - l))),$$

where l is a reserve factor − the difference between borrowing and lending rates; i represents interest rate calculated based on market utilization (share of borrowed funds to the amount of supplied liquidity).

PFLs bring several new specific risks for both borrowers and lenders. Borrowers need to make sure the protocol will not liquidate their collateral. Liquidation can happen if the collateral value decreases or if the protocol increases the liquidation rate. Due to the crypto market's high volatility, liquidation is not hypothetical and can occur in practice. On the other hand, lenders need to ensure APR satisfies their invest-
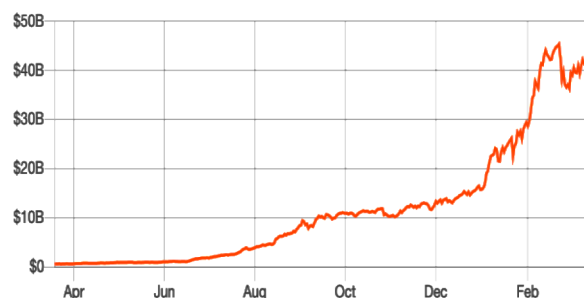

Fig. 4. Total value locked in USD dollars across DeFi protocols [20−23, 24]

ing strategy continuously. Also, investors are vulnerable to a "bank run" situation due to a possible sharp decrease in Ethereum price.

The model of decentralized cryptocurrency exchanges (DEX) such as Bancor and UniSwap is known as liquidity pool. The concept is based on providing liquidity (represented by two or more crypto assets) into the liquidity pool so that AMM can use it for further trades. After depositing funds, the smart contract behind the protocol returns the Liquid Pool tokens (LPs) to the lender. The liquidity provider may return LP tokens to withdraw the provided liquidity and a trading fee from AMM (Fig. 5, Table 2).

The model of liquidity pool can be described as follows:

1. The agent provides liquidity in the liquidity pool. To omit loss of funds, the agent needs to provide an equal amount of both currencies into the pool.

2. The protocol's smart contract returns LP tokens to the agent.

3. The protocol accumulates a specific percentage of trading fees for the liquidity provider.

The agent returns pool tokens to withdraw the provided liquidity and a share of trading fees from AMM.

Thus, the investing model can be described as

$$P' = Volume \cdot Fee \cdot \frac{P}{Pool\ size}.$$

However, this model does not consider the fluctuations of asset prices on the market. For example, if an investor deposits ETH+DAI in the pool, but ETH price increases, then the investor incurs losses because converting DAI to ETH and holding ETH is more profitable than supplying liquidity to the liquidity pool.

The key problem for AMM DEXs is that a liquidity provider is always interested in maximizing the return. Thus, investors are motivated to seek the highest trading fee on different AMM exchanges. A newly started DEX can drain the liquidity from other DEXs by increasing the liquidity providers' reward fee. Thus, it is crucial for a decentralized exchange to keep its liquidity providers in the pool. The same also applies to protocols of loanable funds.

One of the key aspects of decentralized financial instruments is the community supporting the protocol and introducing new changes. This idea introduced a new idea of issuing "governance tokens", allowing the token owners to vote for decisions raised in the community. The idea of a community publicly voting for a change in the protocol by stacking their tokens in the pool.

Fig. 5. APY% rates for USDC fiat-backed stablecoin lending across PFLs [23, 24]

Table 2

Annual Sharpe ratio for USDC stablecoin lending on PFLs

	Compound	AAVE	dYdX
USDC	0.83	0.9	0.85

To motivate liquidity providers to keep their funds in the specific DeFi, a new investment model emerged – Liquidity Mining, also known as Yield Farming. To incentivize liquidity providers to keep their funds, the protocol can reward liquidity providers with governance tokens for keeping their liquidity on the DEX. Given the tokens are also based on the same smart-contract network, governance tokens can be traded on other exchanges, including centralized exchanges. Potential profits from reselling governance tokens motivate investors to keep the liquidity in the pool to obtain a trading fee from AMM and profit from reselling governance tokens. In this case, the investor becomes more dependent on the governance token price and the community's planned protocol changes.

It is hard to make any estimates of expected returns on long-term investments into Liquidity Mining because investment profitability depends on a range of factors. For example, to estimate the expected returns from liquidity mining strategy of UNI governance token distributed by UNISWAP exchange, the investor needs to consider the following factors:

1) price of the UNI governance token;

2) daily distribution of UNI tokens for the particular liquidity pool;

3) size of the pool, to which the investor provides liquidity;

4) expected trading volume in the pool to calculate the expected returns from trading fees.

In the Liquidity Mining model, a protocol's participants receive a share of governance tokens proportionally to their activity on the platform or their investment.

For example, Compound protocol distributes tokens between markets proportionally to interest rates, 50 % of governance tokens are distributed to lenders and another 50 % to borrowers

$$P_{gov} = Tokens\ Distributed\ Per\ Block \times$$
$$\times Share\ distributed\ to\ lenders \cdot \frac{P}{Pool\ Size} \cdot Token\ Price.$$

Liquidity Mining drastically changes the look of PFL from the investor's perspective

$$P_{k+1} = P_k + P_{lending} + P_{gov}.$$

The DeFi ecosystem's diversity, high volatility of cryptocurrencies prices, and network transaction fees made investors aggressively seek the most profitable strategies. This environment created conditions suitable for the appearance of yield aggregators. Yield aggregator is a decentralized protocol based on the liquidity pool model that allocates invested funds across the most profitable investing models in DeFi.

The concept behind yield aggregators is a mix of liquidity pool model and robo-advisor concept. Investors may reduce risks associated with high network transaction fees and low collateral/debt ratio by investing in yield aggregators. Yearn. Finance is an example of a yield-aggregator platform that allows users to invest in the most profitable investing schemes across different DeFi protocols and manages user-provided funds to maximize profits from lending and liquidity mining [25]. Yield aggregators may combine investments in liquidity mining and PFLs to maximize returns.

Results. Currently, the sharp increase in the crypto-assets market capitalization that has started in late 2020 can be observed. Given the presently available DeFi ecosystem technically based on Ethereum, significant Ethereum price growth can influence decentralized finance protocols and increase DeFi investing options' profitability. The amount of ETH locked in the DeFi ecosystem increased from $2.6 billion on 1 June 2020 to $9 billion on 1 October 2020 (Fig. 6).

As was already mentioned, investors have several investment options in the cryptocurrency market: CeFi lending platforms, AMM DEX, DeFi protocols for loanable funds. Given that Bitcoin or other cryptocurrencies can be considered a

Fig. 6. Total market capitalization of cryptocurrency assets [20, 21, 26]

store of value, investors can also hold BTC or ETH passively and do not invest in any option.

The above-mentioned investment models can be compared with a passive holding of BTC and ETH and traditional investing options. UNI and COMP tokens can be selected to estimate the Sharpe ratio for the liquidity mining model, given UniSwap is the biggest DEX by TVL and Compound is the biggest PFL by TVL (Tables 3, 4).

Table 3

Characteristics of available investing options

	Description	Risk factors
Lending on Centralized platforms (Binance, Block.Fi, CoinLend)	ROI may vary depending on platform and market conditions. In Feb-March 2021, the average rate for USD stablecoins was 6 %	Centralized platforms may comply with KYC and AML rules. Centralized model may minimize operational risks, but it also decreases transparency
Liquidity Mining + AMM	The investor receives trade fees and governance tokens proportionally to the share of provided liquidity	High operational risks due to possible vulnerabilities in smart contract and fraud activities in the community. Price of governance tokens depends on the state of the protocol
Lendings on PFLs + Liquidity Mining	The investor receives interest from lending and governance tokens proportionally to the share of provided liquidity	High operational risks due to possible vulnerabilities in smart contract and fraud activities in the community. Price of governance tokens depends on the state of the protocol

Table 4

Sharpe ratio for investments in USD in traditional and cryptocurrency options (March 17, 2020 − March 17, 2021)

S&P 500 Index stock	2.58
APPL stock	2.6
BTC (hold)	11.76
ETH (hold)	15.7
CeFi USD stablecoin lending (Binance)	1.2
DeFi USD stablecoin Lending (Compound)	0.83
UNI (all time data, since 17 Sep 2020)	2.85
COMP (all time data, since 17 June 2020)	3.10

It is important to note that the crypto market has been growing rapidly since the beginning of the pandemic. The calculations for crypto assets might be influenced by the "bull run" on the crypto market because the last time so high Sharpe ratio for BTC and ETH was observed during the 2017−2018 cryptocurrency bubble. Investing in the crypto market is riskier than investing in the stock market due to high operational risks. Thus, it is likely that conservative investors would prefer to invest in S&P 500 or APPL stocks rather than mining COMP or UNI tokens.

Cryptocurrencies show some differences from electronic payment systems in the following aspects: fixed cryptocurrency issuance, dynamic transaction price, dynamic demand for cryptocurrencies, potential inability to regulate, high volatility, fixed transaction time, speculative security of certain types of cryptocurrencies.

Note. S&P 500, APPL, BTC, ETH data from investing. com. UNI and COMP data from coinmarketcap.com. For Binance lending rate, we assume the standard deviation should be computed based on the difference between Flexible Savings and Fixed Savings rates. The risk-free savings rate is 0.

Discussion. Crypto market investors might prefer to mine or buy UNI or COMP tokens to diversify their portfolio. These tokens have a good Sharpe ratio and can outperform ETH or BTC during periods of stability on cryptocurrency markets because investments in PLFs and AMM do not incur losses if asset prices are stable. Given the current DeFi ecosystem is based on Ethereum, DeFi may likely experience a sharp decrease by following ETH prices.

Factors influencing the integration of cryptocurrencies at the enterprise are the nature of the ones, the instability of the national currency, the development of information technology. Cryptocurrency investing is still a new growing market with its unique risks related to the cryptocurrency domain's specific technical barriers, volatility of prices, and high operational risks. This research can represent a foundation for further study of yield aggregator platforms, liquidity mining concepts, and platforms for loanable funds in cryptocurrency investing markets based on decentralized and centralized finance ecosystems.

Conclusions. This paper presents an overview of investing models in cryptocurrency markets based on centralized finance and decentralized finance concepts, including centralized lending platforms, protocols for loanable funds, decentralized exchanges based on Automated Market Maker mechanism, liquidity mining concept, and yield aggregator platforms. For this research, leading protocols, and platforms on CeFi and DeFi markets with the highest trading volume or Total Value Locked indicator were analyzed: centralized lending platforms and cryptocurrency exchanges (Binance, Crypto.com, Block.fi, etc.), PFLs (Compound, AAVE, dYdX), AMM DEX (Uniswap) [25, 26].

It was confirmed that the Sharpe ratio of investments in protocols for loanable funds (without rewards from liquidity mining) is lower compared to investment options on the stock market or CeFi lending. It is also potentially riskier due to volatile interest rates and high operational risks. This confirms that the liquidity mining model currently attracts investors and maybe a potential root cause of increasing TVL indicator in 2020−2021. It was found that interest rates for USD stablecoins on CeFi platforms for loans and savings accounts are volatile, and the interest rate for USD investments has increased significantly since summer 2020. This also can be a potential signal of liquidity mining growth in the DeFi ecosystem.

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Інвестиційні моделі на централізованих і децентралізованих ринках криптовалют

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Мета. Значний приплив капіталу на криптовалютний ринок і рекордні ціни на криптовалютні активи, що супроводжуються розробкою смарт-контрактів, призвели до створення альтернативних варіантів інвестування. Мета дослідження — розглянути варіанти інвестування у промисловість, доступні інвесторам на криптовалютних ринках і децентралізованих протоколах.

Методика. У роботі використана модель децентралізованих криптовалютних бірж, що заснована на оцінці пулу ліквідності.

Результати. Результати дослідження демонструють, що нові промислові інвестори у криптовалюту мають широкий спектр варіантів інвестування, які можуть перевершити такі стратегії, як пасивне утримання криптовалюти або інвестування в акції. Ураховуючи те, що модель liquidity mining приваблює ранніх інвесторів, їм потрібно звертати увагу на такі активи, як токени. Коефіцієнт Шарпа токенів COMP і UNI вище, ніж S&P500. Крім того, токени отримуються за допомогою моделі liquidity mining.

Наукова новизна. Ринок криптовалют стрімко зростає з початку пандемії. На розрахунки криптовалютних активів впливає ситуація "bull run" на ринку криптовалют, оскільки востаннє таке високе співвідношення коефіцієнта Шарпа для BTC і ETH спостерігалося під час криптовалютної бульбашки 2017—2018 років. Інвестування у криптовалютний ринок є більш ризикованим, ніж інвестування у фондовий ринок через високі операційні ризики. Інвестори криптовалютного ринку можуть віддати перевагу майнінгу або купівлі токенів UNI або COMP для диверсифікації свого портфелю.

Практична значимість. За результатами аналізу, різке співвідношення вкладень у протоколи для позичкових коштів є нижчим порівняно з варіантами інвестування на фондовому ринку або кредитування CeFi. Це є також потенційно більш ризиковим через нестабільні процентні ставки та високі операційні ризики.

Ключові слова: *інвестиційні моделі, криптовалюта, AMM, PFL, DEX, LP, процентна ставка, ризик*